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LEVEL II

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SUSQUEHANNA RIVER BASIN
PARTNERS CREEK, SUSQUEHANNA COUNTY

PENNSYLVANIA

ACRE POND DAM

NDI ID NO. PA-00973
DER ID NO. 58-34

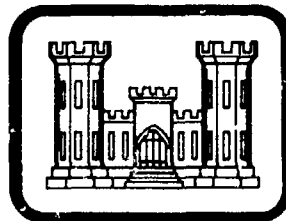
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ACRE LAKE IMPROVEMENT ASSOCIATION

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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DEC 31 1981

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Prepared by
Geo-Technical Services, Inc.
CONSULTING ENGINEERS & GEOLOGISTS
851 S. 19th Street

Harrisburg, Pennsylvania 17104
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For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

AUGUST 1981

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SUSQUEHANNA RIVER BASIN
PARTNERS CREEK, SUSQUEHANNA COUNTY
PENNSYLVANIA

ACRE POND DAM

NDI ID NO. PA-00973
DER ID NO. 58-34

ACRE LAKE IMPROVEMENT ASSOCIATION

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DACW31-81-C-0019

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For
Department of the Army
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August 1981

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonable possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
BRIEF ASSESSMENT OF GENERAL CONDITION

AND
RECOMMENDED ACTION

Name of Dam: Acre Pond Dam
NDI ID No. 00973
DER ID No. 58-34

Size: Small (11.5 feet high; 234 acre-feet)

Hazard Classification: Significant

Owner: Acre Lake Improvement Association
c/o Warren Maxon, President
818 12th Avenue
Scranton, Pa. 18504

State Located: Pennsylvania

County Located: Susquehanna

Stream: Partners Creek

Date of Inspection: July 13, 1981

Based on visual inspection, Acre Pond Dam is judged to be in fair structural condition. In the absence of an adequate spillway, the dam is subject to frequent overtopping. Based on the location of the downstream dwellings and the fact that a few lives could be lost should the dam fail, the dam is classified as a significant hazard dam. Based on criteria established for these studies, the recommended Spillway Design Flood (SDF) varies between the 100-year flood and 1/2 of the Probable Maximum Flood (1/2 PMF). Because of the small reservoir storage capacity, the 100-year flood was selected for the SDF. The present spillway capacity is 73 cfs and that estimated for the SDF is 1830 cfs. Since the spillway cannot pass the 100-year flood without overtopping the dam, the spillway is rated as inadequate.

Although there is some seepage thru the dam, there is no evidence of structural instability.

There is no formal inspection and maintenance program or warning system and evacuation plan in effect at Acre Pond Dam.

The dam is not properly maintained, as indicated by the weed choked spillway approach channel and the loose stone slabs in the spillway crest and sidewalls.

ACRE POND DAM

The following investigations and remedial measures are recommended for immediate implementation by the owner:

- (1) Increase the spillway capacity to pass at least the 100-year flood flow without overtopping the dam.
- (2) Remove the weeds from the spillway approach channel.
- (3) Provide a means to draw down the reservoir level in emergencies.
- (4) Monitor the rate and clarity of the seepage flow and take appropriate action as necessary should any significant changes occur.

All investigations, monitoring programs and design of remedial measures should be performed by a Professional Engineer experienced in the design and construction of dams.

In addition, the owner should institute the following operational and maintenance procedures:

- (1) Develop an emergency warning system which should include round-the-clock monitoring of the dam during periods of unusually heavy rains and a plan to contact the few downstream residents who would be affected by a dam failure.
- (2) Institute an inspection program so that the dam is inspected frequently. As presently required by the Bureau of Dams and Waterway Management of PENNDEER, the program shall include an annual inspection of the dam by a Professional Engineer, experienced in the design and construction of dams. Deficiencies found during annual inspection should be remedied as necessary.



Submitted by:

GEO-TECHNICAL SERVICES, INC.

Gideon Yachin
GIDEON YACHIN, P.E.

Date: August 31, 1981

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

James W. Peck
JAMES W. PECK
Colonel, Corps of Engineers
District Engineer
Date: 10 Sep 81

ACRE POND DAM (PA-00973)
(ARROW POINTS TO DAM)



OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
ACRE POND DAM
NDI# PA-00973, PENNDER# 58-34

SECTION 1
GENERAL INFORMATION

1.1 Authority.

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

1.2 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

1.3 Description of Project.

a. Dam and Appurtenances: Acre Pond Dam is a composite structure consisting of an upstream earthfill embankment with a slope of 1V:6H (1 Vertical on 6 Horizontal) and a downstream near-vertical dry stone masonry wall. The dam has a maximum height of 11.5 feet and a total length of 57 feet, including the spillway. The spillway, located on the left half of the dam, consists of a loose stone slab weir and a vertical downstream dry stone wall with a 2.5' deep plunge pool at its base. The 25-foot long spillway is a rectangular broad crested weir with a very irregular crest elevation. A former sluiceway (30" CIP) is now plugged with concrete. The only other outlet through the dam is a 2-inch diameter steel pipe that discharges about 15 GPM for downstream riparian rights.

b. Location: Acre Pond Dam is located on Partners Creek, a tributary of Tunkhannock Creek in, Lenox Township, Susquehanna County, 1.5 miles north-west of the intersection of Interstate Route I 81 and U.S. Route 106. The dam and reservoir are contained within the Lenoxville, Pennsylvania 7.5 minute series USGS Quadrangle Map, at Latitude N 41°43'00" and Longitude W 75°41'56". A Location Map is shown on Exhibit E-1.

c. Size Classification: Small (11.5 feet high: 234 acre-feet storage capacity at top of dam).

d. Hazard Classification: Significant (see paragraph 3.1e).

e. Ownership: Acre Lake Improvement Association, c/o Warren Maxon, President, 818 12th Avenue, Scranton, Pennsylvania 18504.

f. Purpose of Dam: The original purpose of the impounded water was to power a grist mill and furniture factory owned by Forest Whiting. At the present time, the lake area is used for recreation.

g. Design and Construction History: See paragraph 2.2.

h. Normal Operational Procedure: The pool is maintained at the spillway crest elevation with excess inflow discharging over the spillway into Partners Creek. A 2-inch diameter steel pipe releases about 15 GPM for downstream riparian rights. A former 30" diameter sluice was plugged with concrete to reduce high leakage reported in a 1954 inspection memorandum.

1.4 Pertinent Data.

- a. Drainage Area: (square miles) 3.63
- b. Discharge at Damsite:
- | | |
|---|----------------|
| Maximum known flood at damsite since construction | Not Known |
| Outlet works at maximum pool elevation | Not Applicable |
| Spillway capacity at maximum pool elevation | |
| Design Conditions | Not Known |
| Existing Conditions | 73 cfs |
- c. Elevation: (feet above msl); For datum see paragraph 3.1a
- | | |
|--------------------------------|----------------|
| Top of Dam | |
| Design Conditions | Not Known |
| Existing Conditions | 1204.5 |
| Maximum Pool | |
| Design Conditions | Not Known |
| Existing Conditions | 1204.5 |
| Normal Pool | 1203.0 |
| Upstream Invert Outlet Works | Not Applicable |
| Downstream Invert Outlet Works | Not Applicable |
| Streambed at toe of dam | 1193.0 |
- d. Reservoir Length: (feet)
- | | |
|--------------|------|
| Normal Pool | 4050 |
| Maximum Pool | 4100 |
- e. Storage: (acre-feet)
- | | |
|---|-----------|
| Normal Pool | 160 |
| Maximum Pool | |
| Design Conditions | Not Known |
| Existing Conditions (top of dam Elev. 1204.5) | 234 |
- f. Reservoir Surface: (acres)
- | | |
|-------------|----|
| Normal Pool | 48 |
|-------------|----|

Maximum Pool	
Design Conditions	Not Known
Existing Conditions	54

g. Dam:

Type - Composite earthfill & dry stone masonry	
Length - (feet) (including spillway)	57.0
Height - (feet)	11.5
Top Width (feet)	
Design Conditions	Not Known
Existing Conditions	4
Side Slopes - Upstream: (Earthfill)	1V on 6H
Downstream (Dry stone masonry)	Vertical
Zoning - see type, above.	
Cut-off	Not Known
Impervious Core - Earthfill in 65' long approach channel	
Grout Curtain	Not Known

h. Diversion and Regulating Tunnel: None

i. Spillway:

Type - Broad crested loose stone control section.	
Length of Weir (feet)	25
Crest Elevation - Low point (feet above msl)	1203.0
Top of Side Wall - Low point (feet above msl)	1204.5
Upstream Channel - 65' long earthfill approach channel.	
Downstream Channel - Dry stone walls (about 65' L x 3.5' H).	

j. Outlet Works: None

SECTION 2

ENGINEERING DATA

2.1 Design.

a. There is no available information related to the design and construction of the dam. The earliest information available consists of correspondence, photographs and inspection reports dating back to 1919. The above cited information and related correspondence is available on file with PENNDER.

2.2 Construction Records.

There are no records available for evaluation of construction methods and the classification or quality of materials placed in the dam. The construction of the dry stone wall is described in a 1945 history book of the area, as indicated by the following quotation: "A man by the name of Truesdale came in 1825 and built a dam and grist mill on the opposite side of the creek from the mill which Forest Whiting built. He had built it better than any of them knew. One hundred and twenty years have passed and tons of water have gone over it, and still it stands straight and true." The information available in PENNDER files indicates flooding problems in 1935, 1943 and 1948 due to a small culvert under an old road fill, about 50 feet upstream, across the spillway approach channel. This road fill was removed sometime after August 1965. Severe leakage and low lake levels were reported in 1954. The condition of the dam in 1963 is shown in photos presented in Exhibit E-3. On November 9, 1934, a permit was given to S.T. Raub to repair the dam and install a hydro-electric plant; however, the work was never undertaken.

2.3 Operational Records.

There are no records available to indicate the past operation procedures for the dam. The present normal operation of the facility is described in paragraph 1.3 h, Section 1. Photographs of flooding conditions in 1967, 1972, 1975 and 1976 are shown in Exhibit E-2.

2.4 Other Investigations.

The Pennsylvania Highway Department conducted studies in the mid-1940's and agreed to build a new bridge immediately upstream of the dam. No design reports or drawings are available; however, a September 14, 1954 letter from the Department indicated they could not justify construction costs.

2.5 Evaluation.

a. Availability of Data: Engineering data were extracted from PENNDER

files. The owner stated that he has no plans of the dam. Pertinent dam features were obtained by survey on the inspection date (7/13/1981). There are no other sources of information available for the evaluation of the facility.

b. Adequacy: There are no available plans, engineering specifications or construction records of the dam. Assessment of the structural integrity of the dam and its safety is based on the available cited data, visual inspection, performance history and the hydrologic and hydraulic analyses presented in Section 5. The data available are considered adequate for a Phase I Report.

c. Validity: There is no reason to question the validity of the available data.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General: The overall appearance of the dam is poor. Locations of observed deficiencies are shown on the General Plan presented in Exhibit A-1, Appendix A. The profile and typical sections of the dam are presented in Exhibits A-2 and A-3 and are based on field survey made on the day of inspection. The survey datum for this inspection is elevation 1203.0 feet above mean sea level, which is based on the normal lake surface elevation shown on the USGS topographic map (see Exhibit E-1). On the inspection date (7/13/1981), the lake level was at elevation 1203.5, which is the bottom of the spillway approach channel and is 0.5 foot above the low point on the spillway. Deficiencies observed during the field inspection are described below, and further illustrated in Exhibit A-1, Appendix A. Visible features are depicted in photographs, presented in Appendix C.

b. Dam. Observations made during inspection indicate that the dam is in fair condition. The upstream slope consists of a 65 foot long earthfill plug that serves as the spillway approach channel (see photographs 2, 3, 7 and 8, Appendix C). The earthfill then rises (1V:6H) to the crest of the dry stone wall that forms the downstream face of the dam. The near-vertical downstream wall is about 4 feet wide and 57 feet long, including the 25 feet long spillway section. The left 10 feet of the dam wall is a curved section that terminates parallel to the left abutment slope. The right end of the dam ties into a near vertical dry stone wall that extends downstream along the right abutment for a distance of about 60 feet. Photographs 4, 5, 8 and 9, Appendix C, illustrate these various features. The lowest top of dam elevation is 1204.5, near the right abutment (see Exhibit A-2). On the inspection date, clear leakage from several points on the downstream face totaled about 2 GPM. Near the middle of the dam about 1 foot above the plunge pool is a 2 inch steel pipe that discharges about 15 GPM for downstream riparian rights. The locations of the pipe and observed leakage are shown in Exhibit A-1.

c. Appurtenant Structures:

(1) Spillway: The overall appearance of the spillway is poor. The spillway crest and sidewalls consist of large loose sandstone slabs about 4 feet wide and 6 inches to 1 foot thick (see photograph 4, Appendix C). The crest varies as much as 0.9 foot in elevation (see Exhibit A-2) and low overflows are scattered (see photograph 4, Appendix C). The spillway approach channel is narrow and was choked with weeds on the inspection date (see photograph 3, Appendix C). A plunge pool about 2.5 feet deep is located below the spillway overflow section. Flow is then diverted to a dry stone wall outlet channel (see photographs 8 and 9, Appendix C and Exhibit A-1).

(2) Outlet Works: There are no operational outlet works facilities.

An August 26, 1954 letter reports severe leakage through a 30" CI sluice pipe and closing mechanism in disrepair. This outlet has since been filled with concrete. Its location is illustrated in Exhibit A-1 and photograph 5, Appendix C. The only other outlet is a 2 inch steel pipe drain that discharges about 15 GPM for downstream riparian rights. Its location is shown in Exhibit A-1 and photographs 5 and 6, Appendix C.

d. Reservoir Area: The reservoir area is surrounded by approximately 100 homes and cottages. Slopes on the left shore are wooded and range from 10 to 20 percent. The right shore slopes are partly wooded and vary from 10 to 20 percent. There is no evidence of unstable slope conditions that could affect the stability of the dam. The large flat marsh area upstream of the reservoir and the shallow nature of Acre Pond indicate moderate to high sedimentation and problems related to algae and weeds when the lake level drops. These latter problems have been reported in correspondence in PENNDER files dating back to 1924. At the upstream end of the lake, the head wall of a road culvert is badly cracked (see photograph 10, Appendix C). Pertinent watershed features are presented in Exhibit E-1, Appendix E. Geologic conditions in the area are described in Appendix F.

e. Downstream Channel: Downstream of the dam, for a distance of about 80 feet, the lower part of the outlet channel is a dry stone wall channel, about 10 feet wide with sidewalls ranging from 3 to 4 feet high (see photograph 9, Appendix C). Downstream of the wall the channel is partly wooded and discharges into a highway culvert (15.6' Dia. CMP) about 200 feet downstream. Most of the remaining downstream channel is a natural wooded channel with a gradient of about 3 percent. There are two homes within 6000 feet downstream of the dam, and within 100 feet of the stream, that may be subjected to flooding (see photographs 12 and 13, Appendix C). Should the dam fail, a few lives may be lost. Consequently, Acre Pond Dam is classified as a significant hazard structure.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure.

The reservoir is maintained at normal pool level with excess inflow discharging over the spillway into the plunge pool and the downstream channel. There are no existing provisions for emergency drawdown of the lake. A 2 inch steel pipe near the base of the dam releases about 15 GPM for downstream riparian rights.

4.2 Maintenance of Dam.

Maintenance activities by the present owner appear to be minimal and are considered unsatisfactory. Past history of the dam indicates that maintenance was limited to removal of brush, repair of the stone walls and plugging the leaking sluice pipe with concrete. The spillway crest, side-walls and approach channel require maintenance.

4.3 Maintenance of Operating Facilities.

There are no operating facilities at the dam.

4.4 Warning System in Effect.

There is no emergency operation and warning system in effect at the present time.

4.5 Evaluation.

The maintenance of the dam is unsuitable and periodic inspections are necessary to verify conditions in the spillway and its approach channel. The spillway crest should be repaired to provide uniform overflow, the side-walls should be repaired to prevent washouts and the weeds in the approach channel should be removed. The seepage flows should be monitored to detect any changes in quantity and turbidity. Findings and subsequent maintenance and repair work should be documented. A surveillance program should be developed to detect any adverse conditions at the dam and a method of emergency drawdown should be instituted. An emergency warning system and a formal evacuation plan should be prepared to evacuate the downstream population if adverse conditions develop at the dam.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Design Data.

There are no hydrologic or hydraulic design data available for Acre Pond Dam.

5.2 Experience Data.

There are no records available relative to maximum stages or discharges at the dam. Photographs in Exhibit E-2 reveal frequent overtopping of the dam.

5.3 Visual Observations.

Based on the visual inspection and field survey described in Section 3, the observations relevant to hydrology and hydraulics are evaluated as follows:

a. Embankments: The low point on the spillway is elevation 1203.0 and the low point on the dam is 1204.5, resulting in only 1.5 feet of head over the spillway crest. The variation in dam crest elevation is shown in Exhibit A-2 and is based on the field survey on the inspection data.

b. Spillway: The spillway is an irregularly shaped section formed by large rock slabs and has a 65 foot long approach channel that is restricted by weed growth. The spillway discharges into a plunge pool and then into a dry masonry outlet channel. Hydraulic analyses of the spillway are presented in Appendix D.

c. Reservoir Area: There are no upstream hydraulic structures which would influence flood flow into Acre Pond. Future development to the extent that would alter hydrologic and hydraulic conditions is not anticipated.

d. Downstream Conditions: About 60' downstream of the dam there is a highway embankment and culvert which would affect spillway discharge at high flows. A tailwater analysis is presented in Appendix D.

5.4 Method of Analysis.

Hydrologic and hydraulic evaluation was made in accordance with the procedures and guidelines established by the U.S. Army Corps of Engineers, Baltimore District, Phase I Safety Inspection of Dams. The analysis is presented in Appendix D.

5.5 Summary of Analysis.

a. Spillway Design Flood (SDF): According to criteria established by the office of the Chief of Engineers (OCE), the Spillway Design Flood (SDF)

for the size (small) and hazard potential (significant) of the Acre Pond Dam is between the 100-year flood and the one-half Probable Maximum Flood (1/2 PMF). Because of the small reservoir storage capacity, the 100-year flood is selected as the SDF for the Acre Pond Dam.

b. Results of Analysis: Pertinent results are presented in Appendix D. The analysis reveals that under the prevailing top of dam elevation, the discharge of the spillway is 73 cfs (cubic feet per second) when the water surface in Acre Pond reaches the low point on the crest of the dam. The computed 100-year flood for the 3.63 square-mile drainage area above the dam is 1830 cfs.

5.6 Spillway Adequacy.

Because the present capacity of the spillway will not pass the selected SDF without overtopping the dam, the spillway is rated as inadequate.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations.

The visual inspection of Acre Pond Dam is described in Section 3. Observations relevant to the dam's structural stability are evaluated below:

a. Dam: The dam is a long earthfill plug in a natural channel with a downstream, vertical dry stone wall. Seepage (2 GPM+) through the wall is clear and there is no evidence of piping to suggest internal erosion of the embankment.

b. Appurtenant Structures:

(1) Spillway: The loose rock slabs on the spillway crest are subject to displacement under high flows. There is no significant erosion or evidence of undercutting in the plunge pool.

(2) Outlet Works: There is no operable outlet works.

6.2 Design and Construction Data.

There are no documented design or construction data.

6.3 Past Performance.

The dam has been in place since 1825. Remedial work to correct leakage problems and overtopping damage has been done at various intervals over the dam's life.

6.4 Stability.

a. Static: The dam is considered to be stable under static loading conditions.

b. Seismic: The dam is located in seismic zone 1. If the dam has adequate structural stability under static conditions, it is assumed to be able to withstand the minor seismic forces expected in this zone.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety:

(1) The Acre Pond Dam is judged to be in fair structural condition based on the visual inspection. Based on the location of the downstream dwellings and the fact that a few lives could be lost should the dam fail, the dam is classified as a significant hazard dam. Based on criteria established for these studies, the recommended Spillway Design Flood (SDF) varies between the 100-year flood and 1/2 of the Probable Maximum Flood (1/2 PMF). Because of the small reservoir storage capacity, the 100-year flood was selected for the SDF. The present spillway capacity is 73 cfs and that estimated for the SDF is 1830 cfs. Since the spillway cannot pass the 100-year flood without overtopping the dam, the spillway is rated as inadequate.

(2) A summary of the observed deficiencies is described below:

<u>DESCRIPTION</u>	<u>OBSERVED DEFICIENCIES</u>
Dam	Seepage (2 GPM \pm) through downstream wall.
Spillway	Inadequate capacity to discharge the SDF without overtopping. Weed choked approach channel. Loose stone slabs in spillway crest and sidewalls.
Outlet Works	There is no means to draw down the reservoir in emergencies.

(3) There is no formal inspection and maintenance program or warning system and evacuation plan in effect at Acre Pond Dam.

b. Adequacy of Information: There are no design or construction data available for Acre Pond Dam. The visual inspection and computations performed as part of this study, as well as the past performance of the facility, are sufficient for the Phase I Dam Safety assessment, delineated in subparagraph a., aforementioned.

c. Urgency: The recommendations presented in Section 7.2 should be implemented immediately.

d. Necessity for Further Investigations: In order to accomplish some of the remedial measures outlined in paragraph 7.2, further investigation by a Professional Engineer, experienced in the design and construction of dams will be necessary.

7.2 Recommendations and Remedial Measures.

a. The following investigations and remedial measures are recommended for immediate implementation by the owner.

- (1) Increase the spillway capacity to pass at least the 100-year flood flow without overtopping the dam.
- (2) Remove the weeds from the spillway approach channel.
- (3) Provide a means to draw down the reservoir level in emergencies.
- (4) Monitor the rate and clarity of the seepage flow and take appropriate action as necessary should any significant changes occur.

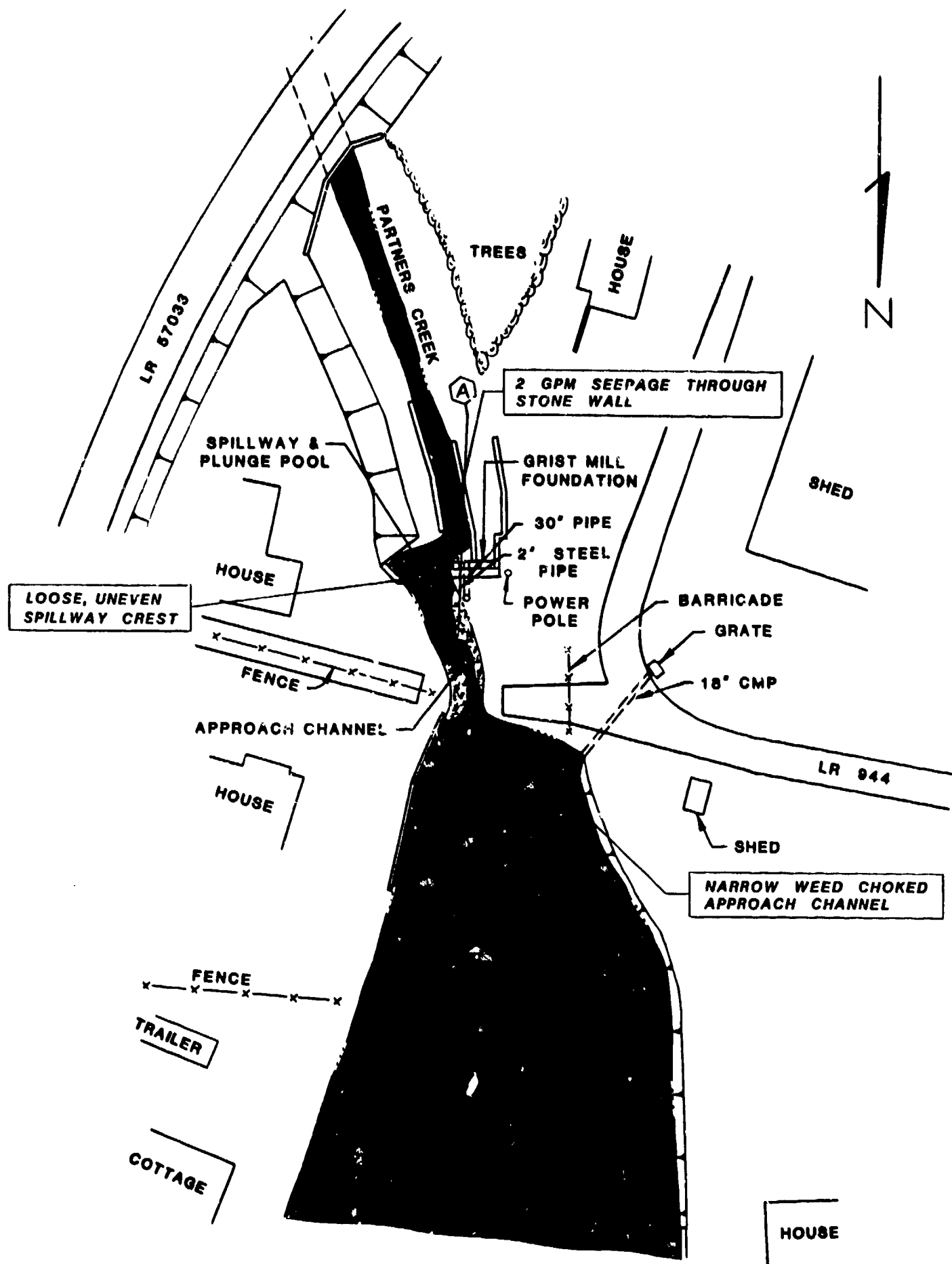
All investigations, monitoring programs and design of remedial measures should be performed by a Professional Engineer, experienced in the design and construction of dams.

b. In addition, the owner should institute the following operational and maintenance procedures:

- (1) Develop an emergency warning system which should include round-the-clock monitoring of the dam during periods of unusually heavy rains and a plan to contact the few downstream residents who would be affected by a dam failure.
- (2) Institute an inspection program so that the dam is inspected frequently. As presently required by Bureau of Dams and Waterway Management of PENNSYLVANIA, the program shall include an annual inspection of the dam by a Professional Engineer, experienced in the design and construction of dams. Deficiencies found during annual inspection should be remedied as necessary.

APPENDIX A

VISUAL INSPECTION - CHECKLIST AND FIELD SKETCHES



**ACRE POND DAM
GENERAL PLAN - FIELD INSPECTION NOTES**

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

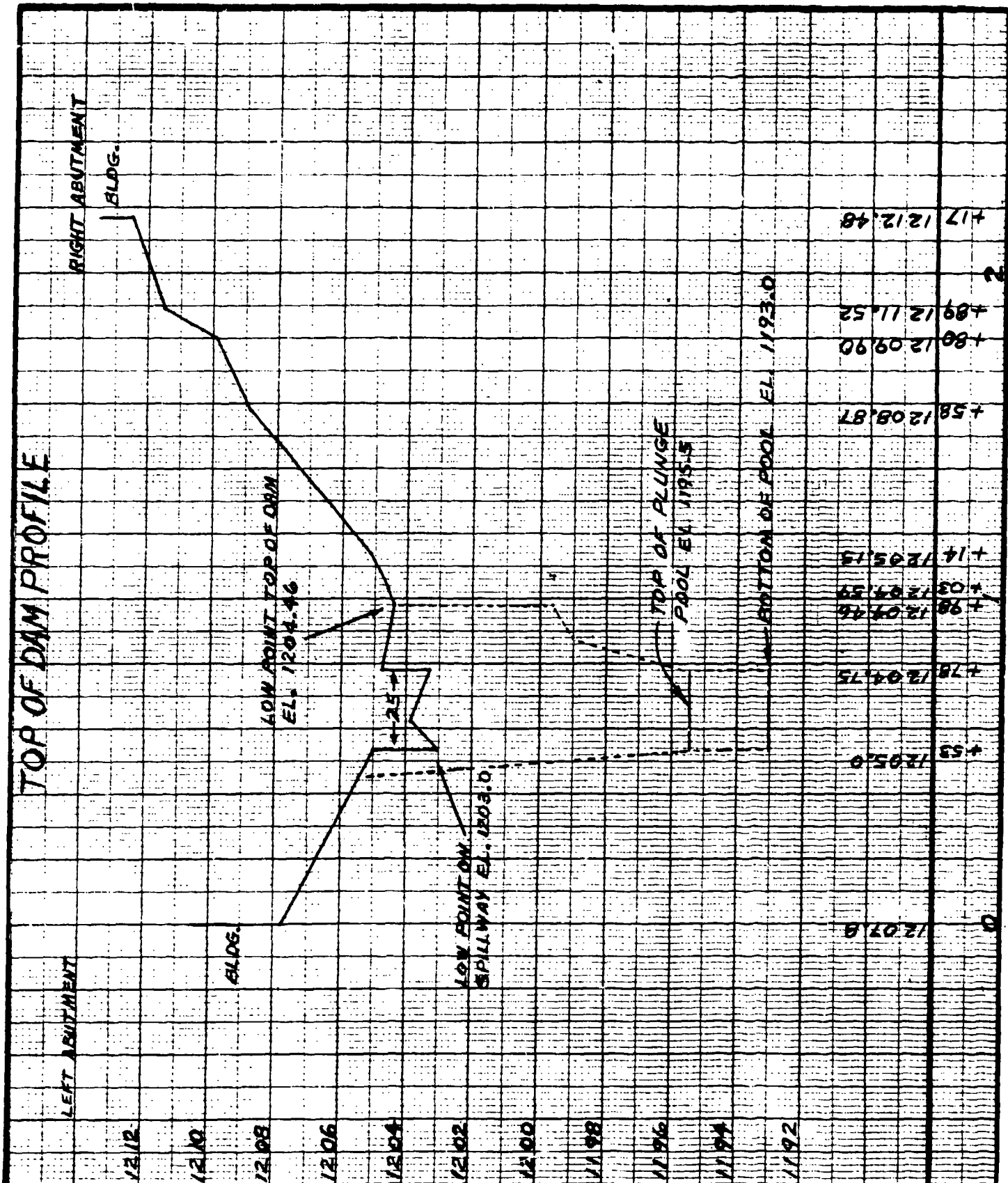
JOB ACRE POND

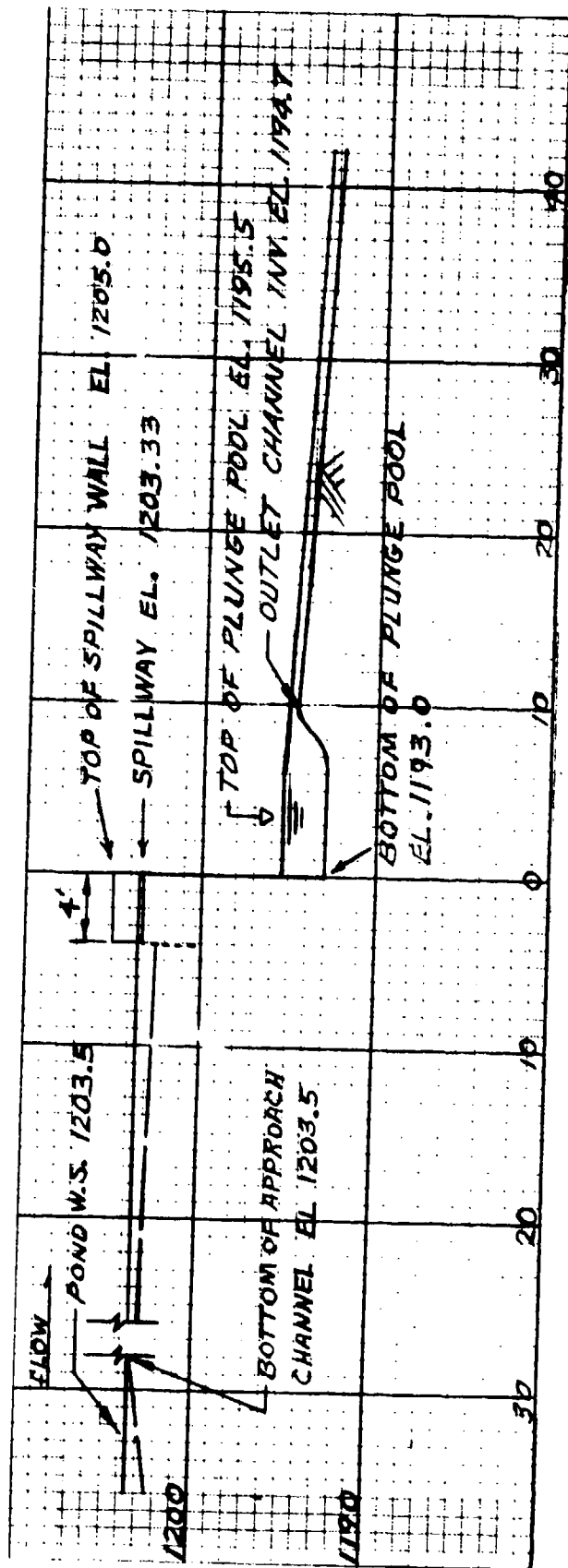
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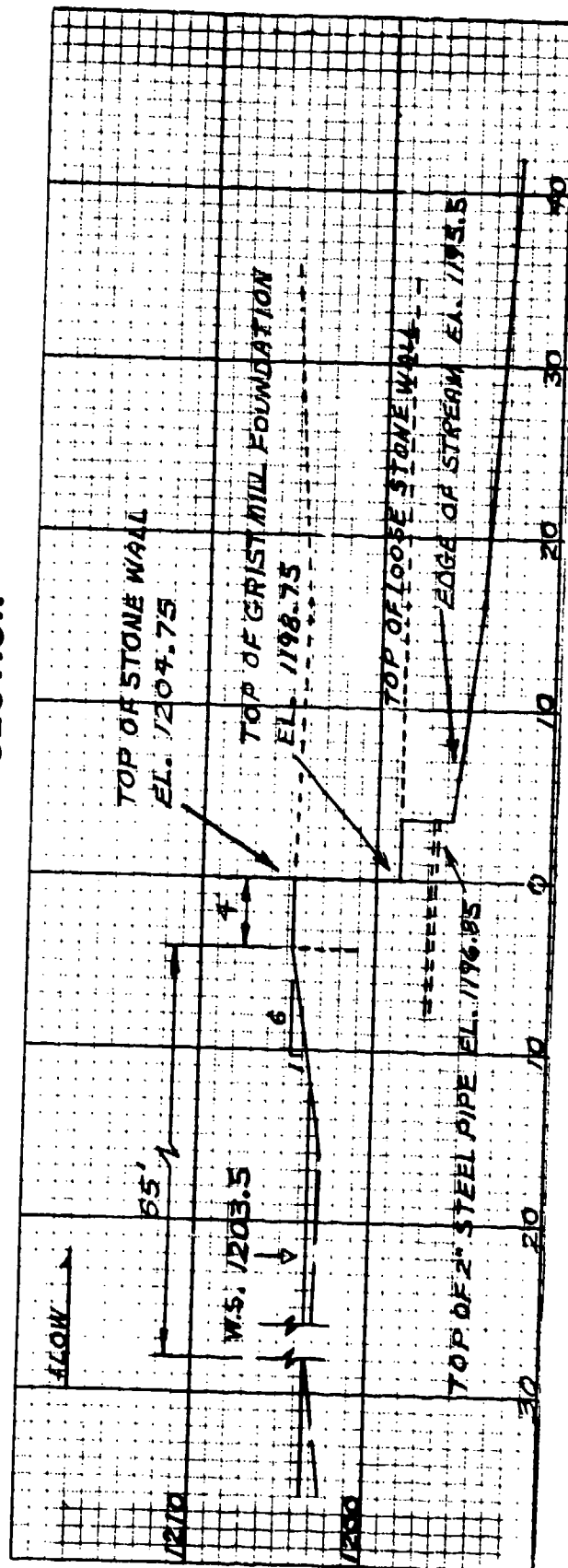
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SCALE HORZ. 1" = 40' VERT. 1" = 4'





SPILLWAY SECTION



SECTION A

TYPICAL DAM SECTIONS

CHECK LIST VISUAL INSPECTION PHASE 1

NAME OF DAM Acre Pond Dam STATE Pennsylvania COUNTY Susquehanna
 NDI # PA - 00973 PENN DER # 58-34
 TYPE OF DAM Dry stone masonry & earth SIZE Small HAZARD CATEGORY Significant
 DATE(S) INSPECTION July 13, 1981 WEATHER Cloudy TEMPERATURE 80° F @ 1:00 p.m.
 POOL ELEVATION AT TIME OF INSPECTION 1203.0 M.S.L.
 TAILWATER AT TIME OF INSPECTION 1195.5 M.S.L.

INSPECTION PERSONNEL	OWNER REPRESENTATIVES	OTHERS
<u>Gideon Yachin, Engineer</u>	<u>Fred Miller, Director</u>	<u>Warren Maxson, Lenox Township</u>
<u>Ronald Mather, Surveyor</u>		
<u>James Diaz, Geologist</u>		

RECORDED BY James Diaz

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS	NDIN PA - 00973
SURFACE CRACKS	None	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The downstream face of dry stone wall has an irregular horizontal alignment. Overflow section of spillway has an irregular vertical alignment.	
RIPRAP FAILURES	No riprap (masonry, dry stone dam with earth fill in approach channel).	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Downstream on right abutment is a dry stone near vertical retaining wall (See Exhibit A-1). On the left abutment, the face of the dam curves downstream (approximately 10') and parallels the abutment.	

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS	NDM PA - 00973
DAMP AREAS IRREGULAR VEGETATION (LUSH OR DEAD PLANTS)	None; Scant growth of weeds on wall immediately right of overflow section.	
ANY NOTICEABLE SEEPAGE	Leakage (2 GPM+) through stone wall (dripping spread over wide area).	
STAFF GAGE AND RECORDER	None	
DRAINS	A 2" steel pipe discharging about 15 GPM (for riparian right releases) is located right of the overflow section and about 1 foot above the plunge pool water level.	
ROCK OUTCROPS	None	

OUTLET WORKS

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS	NDI# PA - 00973
INTAKE STRUCTURE	None at the present time. A local resident reported that a 30" cast iron intake pipe (sluiceway for grist mill) was filled in with concrete.	
OUTLET CONDUIT (CRACKING AND SPALLING OF CON- CRETE SURFACES)	A mass of concrete now covers the outlet of the 30" cast iron pipe.	
OUTLET STRUCTURE	None	
OUTLET CHANNEL	None	
GATE(S) AND OPERA- TIONAL EQUIPMENT	None (original valve stuck, PENNDER files).	

EMERGENCY SPILLWAY

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS	NDI# PA -00973
TYPE AND CONDITION	A broad crested weir constructed with large loose boulders (4' wide). The top surface is very irregular and in poor condition.	
APPROACH CHANNEL	Shallow (6" to 12") narrow (15' to 20') approach channel (see Exhibit A-1) partly filled with weeds.	
SPILLWAY CHANNEL AND SIDEWALLS	Natural banks and a dry stone wall (4'± Wide x 2'± high) at the weir.	
STILLING BASIN PLUNGE POOL	Spillway flow drops about 8 feet to a 2.5 feet deep plunge pool.	
DISCHARGE CHANNEL	Steep bottom slope in first 50' downstream between two vertical dry stone walls. The remaining distance to road culvert downstream of dam is a natural wooded stream channel.	
BRIDGE AND PIERS EMERGENCY GATES	None	

SERVICE SPILLWAY

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS	NDI# PA-00973
TYPE AND CONDITION	None. The former 30" diameter cast iron pipe sluice for a grist mill is now filled with concrete.	
APPROACH CHANNEL	None (now covered with fill).	
OUTLET STRUCTURE	None (Grist mill structure dismantled).	
DISCHARGE CHANNEL	Same discharge channel as emergency spillway.	

INSTRUMENTATION

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS	NDI# PA - 00973
MONUMENTATION SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHERS	None	

RESERVOIR AREA AND DOWNSTREAM CHANNEL

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS	NDI# PA -00973
SLOPES RESERVOIR	The lake shore line contains numerous cottages. Upper slopes range from 10 to 20 percent. There are no slope conditions that would affect the safety of the dam.	
SEDIMENTATION	Moderate amount of sedimentation is indicated by the swamp area upstream and the reported shallow marshy conditions when the lake level drops.	
DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	The highway culvert 200+ <u>'</u> downstream of dam. The top of road is higher than the top of dam.	
SLOPES CHANNEL VALLEY	The downstream channel is a natural wooded channel with a steep gradient of about 3%.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	Two homes.	

APPENDIX B

ENGINEERING DATA - CHECKLIST

**CHECK LIST
ENGINEERING DATA
PHASE I**

NAME OF DAM Acres Pond Dam

ITEM	REMARKS	NDI# PA-00973
PERSONS INTERVIEWED AND TITLE	Fred Miller, Director, Acres Pond Improvement Association Warren Maxon, Supervisor, Lenox Township	
REGIONAL VICINITY MAP	See Exhibit E-1, Appendix E	
CONSTRUCTION HISTORY	The original dam was constructed in 1825 by a man named Truesdale for the owner, Forest Whiting. Severe leakage and low lake levels were corrected by the present owners by plugging a 30" Dia. sluice in 1954. The old road crossing the approach channel was removed sometime after August 1965.	
AVAILABLE DRAWINGS	There are no available design or construction drawings of the dam. Sketches of proposed repair work and installation of a hydro-electric power plant are on file with PENNDEK; however, the proposed work was never undertaken.	
TYPICAL DAM SECTIONS	For plan, profile and typical sections obtained by survey (7/13/81), see Exhibits A-1, A-2 and A-3.	
OUTLETS. PLAN DETAILS DISCHARGE RATINGS	There are no existing outlet works or other means to draw down the reservoir. A 2-inch steel pipe is used to release about 15 GPM for downstream riparian rights.	

**CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)**

ITEM	REMARKS	NDI# PA - 00973
SPILLWAY PLAN SECTION DETAILS	There are no design or construction details of the spillway or the concrete plugged 30-inch CI sluice pipe.	
OPERATING EQUIP. MENT PLANS AND DETAILS	None. The original closing mechanism for the 30-inch CI sluice pipe was not operable and the present owners plugged the pipe with concrete to stop severe leakage.	
DESIGN REPORTS	None available	
GEOLOGY REPORTS	None available	
DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES	None available	
MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING	None available	

**CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)**

ITEM	REMARKS	NDI# PA - 00973
BORROW SOURCES	Not known	
POST CONSTRUCTION DAM SURVEYS	None prior to the present inspection survey.	
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Inspection reports, correspondence and memos are on file with PENDER.	
HIGH POOL RECORDS	No formal records Photographs of various flood levels are shown in Appendix E.	
MONITORING SYSTEMS	None	
MODIFICATIONS	The 30-inch CI sluice pipe was plugged with concrete sometime after August 1954. The road fill across the spillway approach channel was removed sometime after August 1965.	

**CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)**

ITEM	REMARKS	NDI# PA - 00973
PRIOR ACCIDENTS OR FAILURES	Not reported	
MAINTENANCE RECORDS MANUAL	None available	
OPERATION RECORDS MANUAL	None available	
OPERATIONAL PROCEDURES	Self-regulating.	
WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	None available	
MISCELLANEOUS		

**CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA**

NDI ID # PA-00973
PENNDER ID # 58-34

SIZE OF DRAINAGE AREA: 3.63 square miles
ELEVATION TOP NORMAL POOL: 1203.0' STORAGE CAPACITY: 160 acre feet
ELEVATION TOP FLOOD CONTROL POOL: NA STORAGE CAPACITY: NA
ELEVATION MAXIMUM DESIGN POOL: Unknown STORAGE CAPACITY: NA
ELEVATION TOP DAM: 1204.5 STORAGE CAPACITY: 234 acre feet

SPILLWAY DATA

CREST ELEVATION: 1203.0 (feet above m.s.l.)
TYPE: Broad crested weir
CREST LENGTH: 25.0 feet
CHANNEL LENGTH: 65.0 feet (Approach Channel)
SPILLOVER LOCATION: Left side of dam
NUMBER AND TYPE OF GATES: None

OUTLET WORKS

(No existing outlet works)

TYPE: _____
LOCATION: _____
ENTRANCE INVERTS: _____
EXIT INVERTS: _____
EMERGENCY DRAWDOWN FACILITIES: _____

HYDROMETEOROLOGICAL GAGES

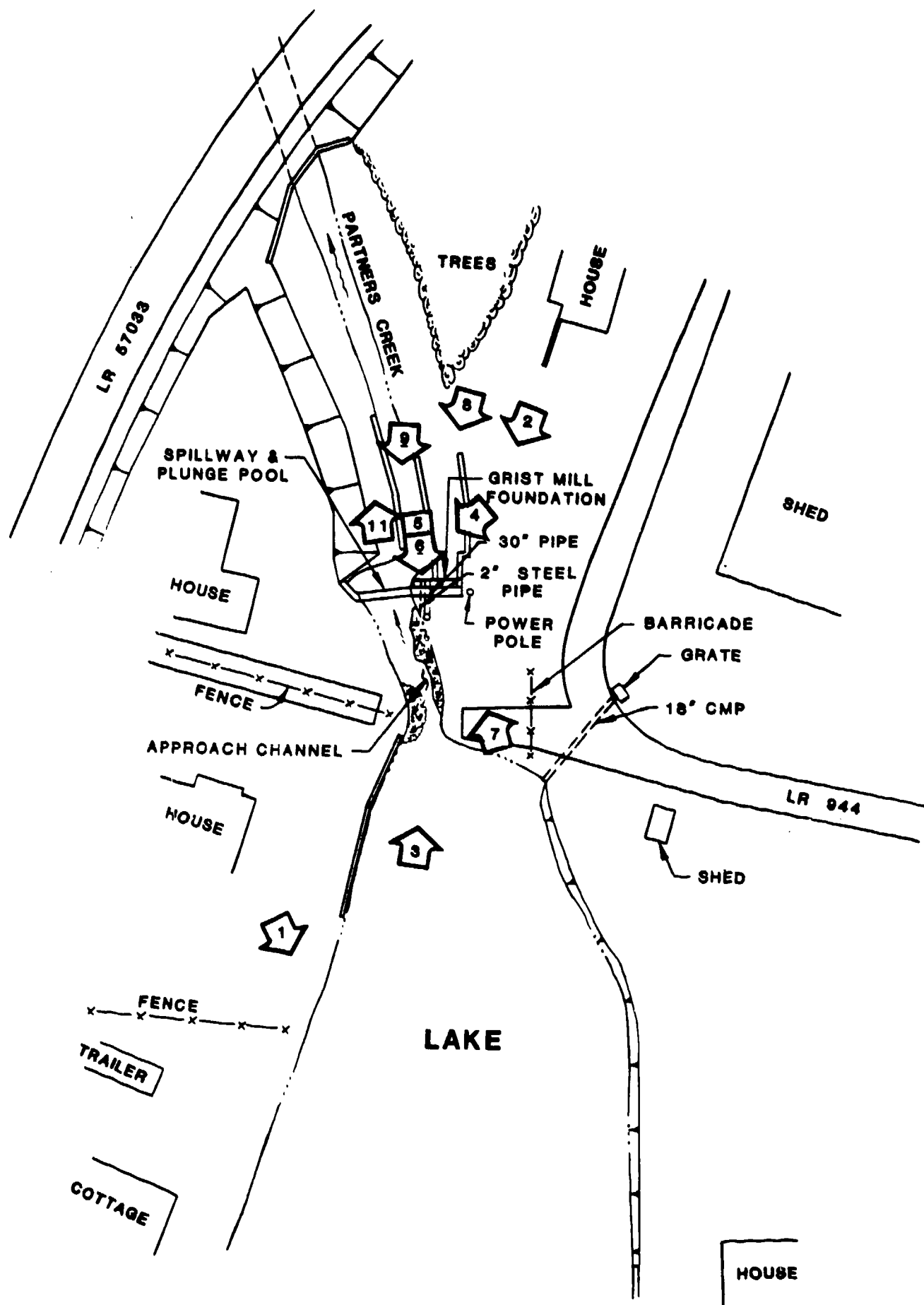
(None)

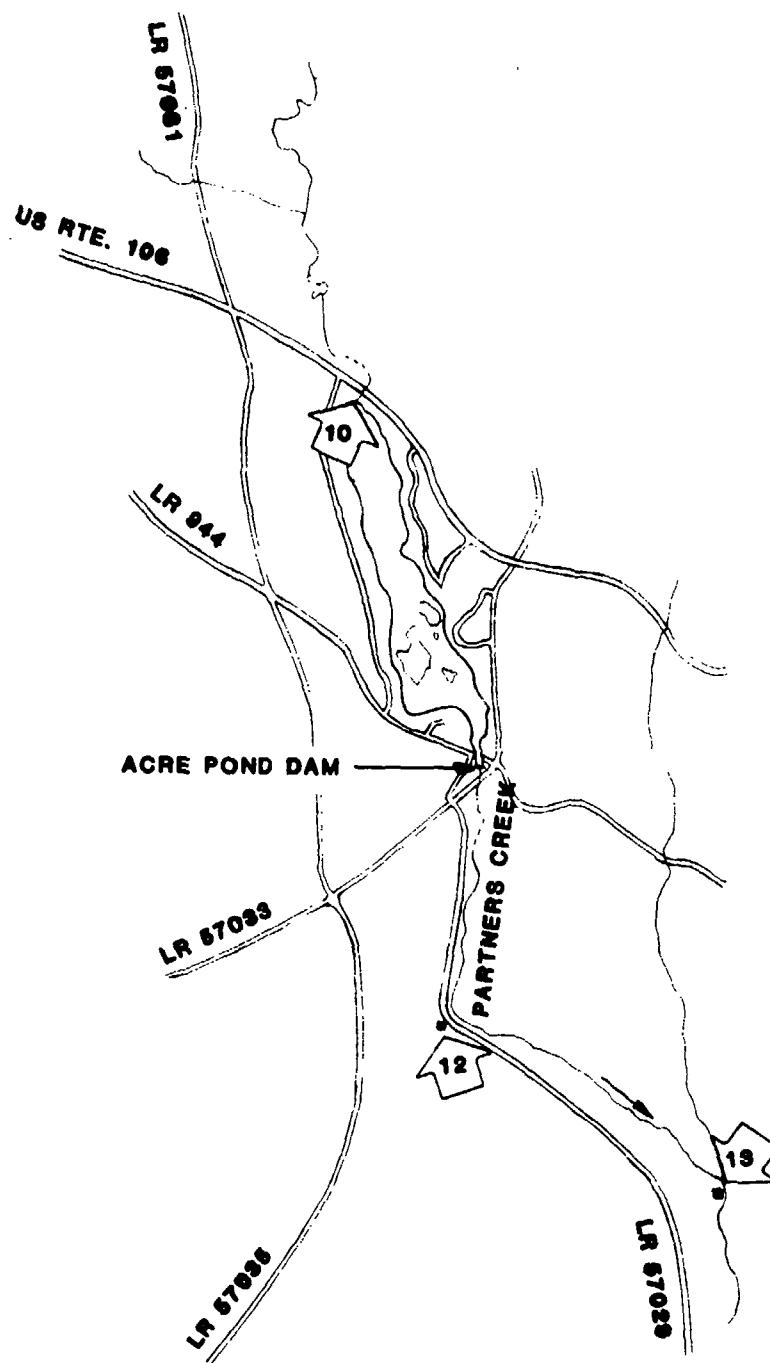
TYPE: _____
LOCATION: _____
RECORDS: _____

MAXIMUM NON-DAMAGING DISCHARGE: 73 cfs

APPENDIX C

PHOTOGRAPHS





ACRE POND DAM
UPSTREAM & DOWNSTREAM PHOTOGRAPHS LOCATION MAP



1. GENERAL VIEW OF LAKE AND SHORELINE



2. UPSTREAM VIEW OF APPROACH CHANNEL;
LAKE AND OLD ROAD ON LEFT, DAM ON RIGHT



3. DOWNSTREAM VIEW OF WEED CHOKED APPROACH CHANNEL,
DAM IS LEFT OF POLE



4. VIEW OF DAM SHOWING UNEVEN DAM CREST AND PLUNGE POOL. GRIST MILL FOUNDATIONS ON LEFT



5. CLOSEUP OF GRIST MILL FOUNDATIONS. PLUGGED END OF 30" PIPE IS WHITE AREA IN LOWER LEFT. 2" STEEL PIPE IN LOWER RIGHT



6. CLOSEUP OF 2" STEEL PIPE DISCHARGING RIPARIAN RELEASES. PLUGGED 30" PIPE IS IN LEFT OF PHOTO



7. DOWNSTREAM VIEW OF APPROACH CHANNEL,
DOWNSTREAM CHANNEL AND ROAD CULVERT



8. UPSTREAM VIEW OF NARROW APPROACH CHANNEL TO RIGHT OF MAIN CHANNEL



9. UPSTREAM VIEW OF OUTLET CHANNEL WALLS



10. UPSTREAM VIEW OF CRACKED CULVERT
AT UPSTREAM END OF LAKE



11. DOWNSTREAM VIEW OF STREAM CHANNEL
AND ROAD CULVERT 200' DOWNSTREAM



12. VIEW OF RESIDENCE 2500' DOWNSTREAM.
MAN ON RIGHT STANDING IN STREAM CHANNEL



13. VIEW OF RESIDENCE 6000' DOWNSTREAM.
STREAM IN LOWER LEFT OF PHOTO.

APPENDIX D

HYDROLOGY AND HYDRAULICS

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB ACRE POND
SHEET NO. 1 OF 1
CALCULATED BY spm DATE 5/81
CHECKED BY _____ DATE _____
SCALE _____

GENERAL DATA - ACRE POND DAM

RIVER BASIN STREAM NAME	SUSQUEHANNA PARTNERS CREEK
NDI I.D. NO	PA-0973
DER I.D. NO	58-034
OWNER	ACRE LAKE IMPROVEMENT ASSOCIATION
LOCATION	LENOX TWP.
CO.	SUSQUEHANNA
QUAD.	LENOXVILLE
LAT.	41° 43' - 00"
LONG.	75° 41' - 56"
SIZE	SMALL
HAZARD	SIGNIFICANT
DRAINAGE AREA	3.63 mi ²

Watershed Features

Steep wooded slopes
some mod. sloped farmed area
< 1% DEVELOPED
FEW SWAMP AREAS ALONG VALLEY FLOORS

REGIONAL VICINITY
AND
WATERSHED BOUNDARY MAP

Polk
Pond

Peck
Cem
BM
1092

HARFORD, PA.

N4145—W7537.5/7.5

1968
PHOTOREVISED 1978
AMS 5867 I SW—SERIES V831

LENOXVILLE, PA.

N4137.5—7537.5/7.5

1946
PHOTOREVISED 1969
AMS 5867 II NW—SERIES V831

3.63 mi.

Morgan

H A R F O R D

WATERSHED BOUNDARY

LONGEST WATERCOURSE
CENTROID OF DRAINAGE AREA

D-2

ACRE POND DAM

EXHIBIT E-1

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB NDI - PA
SHEET NO _____ OF _____
CALCULATED BY Sfm DATE 8/81
CHECKED BY _____ DATE _____
ACRE POND

POND STORAGE

NO BULLETIN #5 (FINDER) AVAILABLE

POND AREA @ EL. 1203 - NORMAL POOL* = 48 AC.

AREA @ CONTOUR ELEV. 1220 = 118 AC

* USGS QUAD.

ASSUME BOTTOM OF LAKE = 1193.0

LOW POINT ON TOP OF DAM = EL. 1204.46

INTERPOLATED AREA @ 1204.46

$$\Delta = 48 + \frac{(1.46) 70}{17} = 54$$

VOL. AT LOW PT.

$$V_{MAX} = \frac{10}{3} (48) + \frac{1.46}{3} (54 + 48 + \sqrt{54 \times 48}) =$$
$$= 234 \text{ ACFT. (MAX. POOL)}$$

NORMAL POOL (ie low point on spillway) = 160 ACFT

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB ACRE POND DAM

SHEET NO. _____

OF _____

CALCULATED BY JK

DATE 7/18/

CHECKED BY _____

DATE _____

SCALE _____

DETERMINE 100 YR. FLOOD

REF. 1) C.O.E. MEMO 4/22/81

2) BULLETIN No. 13 - FLOODS IN PA. - USGS OCT. 1977

3) HYDROLOGIC STUDY - TROPICAL STORM AGNES - COE DEC. 1975

METHOD A

COE REGIONAL REGRESSION (REF. 3)

$$\log(Q_m) = C_m + 0.75 \log(A)$$

$$A = 3.63 \text{ mi}^2$$

$$C_m = 2.1 \text{ (fig. 21)}$$

$$\log(Q_m) = 2.1 + 0.75 \log(3.63) = 2.52$$

$$S = C_s - 0.05 \log(A)$$

$$C_s = 0.35 \text{ (fig. 22)}$$

$$S = 0.35 - 0.05 \log(3.63) = 0.32$$

$$\log(Q_p) = \log(Q_m) + K_{pg} S$$

$$p = 100 \text{ yr}$$

$$g = 0.3 \text{ (fig. 23)}$$

$$K_{pg} = 2.55$$

$$\log(Q_{100}) = 2.52 + 2.55(0.32) = 3.34$$

$$Q_{100} = 2187.8 \quad \text{Say } 2190 \text{ cfs}$$

METHOD B

BULL # 13 (ref. 2)

$$Q_T = c A^x \quad \text{Region 2}$$

$$T = 100$$

$$c = 564$$

$$x = 0.744$$

$$Q_T = 564 (3.63)^{0.744} = 1472 \text{ cfs} \quad \text{say } 1470 \text{ cfs}$$

AVERAGE VALUE OF METHODS A & B

$$Q_{100} = \frac{Q_T + Q_p}{2} = \underline{\underline{1830 \text{ cfs}}}$$

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB NDI - PA

SHEET NO. _____

OF _____

CALCULATED BY gfm

DATE 8/81

CHECKED BY _____

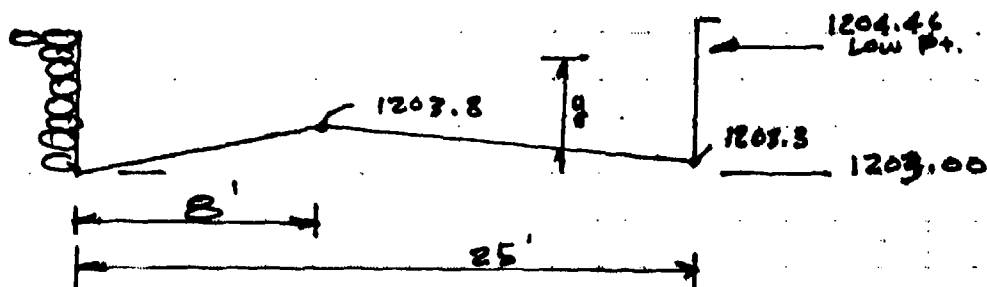
DATE _____

ACRE POND

SALLWAY RATING

SALLWAY IS AN IRREGULARLY SHAPED CONTROL SECTION WITH AN APPROACH CHANNEL.

ASSUME AT HIGH FLOWS THE FOLLOWING SHAPE CONTROLS FLOW



ASSUME CRITICAL DEPTH CONTROL

$$\frac{Q^2}{g} = \frac{A^3}{T}$$

$$\text{Pond Elev.} = 1203 + y + \frac{v^2}{2g}$$

<u>y</u>	<u>A</u>	<u>Q</u>	<u>POND Elev.</u>	
1.0	12.5	49.9	1204.2	
1.1	15.0	65.9	1204.4	(1204.40)
1.2	17.5	83.1	1204.6	(1204.55)

MAX DISCHARGE AT MAX POND EL.

$$Q_{max} = 65.9 + 17.2 \frac{(.06)}{.15} = 73 \text{ cfs}$$

$$Q_{100} = 1830 \text{ cfs}$$

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB NDI - MA

SHEET NO. _____

OF _____

CALCULATED BY SPW

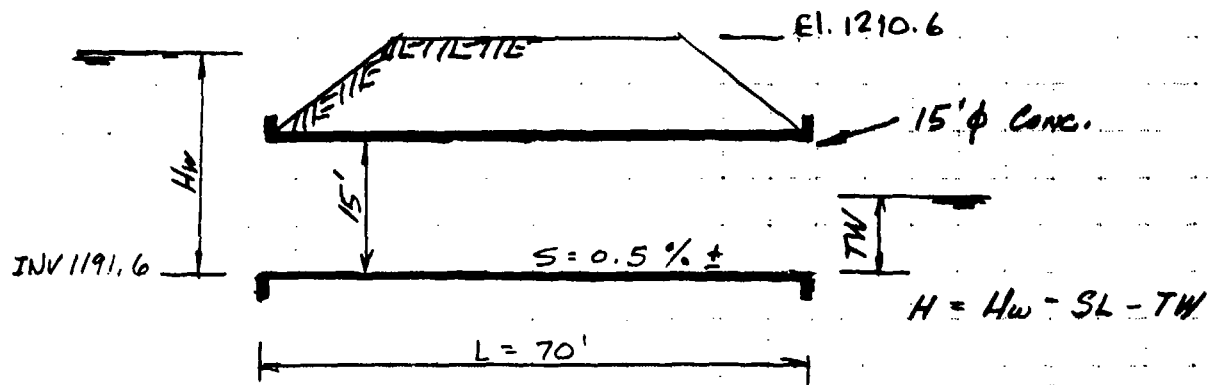
DATE 8/81

CHECKED BY _____

DATE _____

ACRE POND DAM

CHECK TAILWATER CONDITIONS AT HIGHWAY CULVERT



SECTION

INLET CONTROL (BPR CHARTS)

H_w/D	Q	Elev.
0.76	1650	1203
1.00	2500	1206.6
1.27	3100	1210.6

Check Outlet Control Conditions

$h_f < 0.1$ ignore friction loss.
treat as short tube

$$Q = 0.6 \sqrt{E_g H}$$

$$= 850.9 \sqrt{H}$$

Assume T.W. @ 0.5 D

$$H_w = H + 7.5 + .005(70)$$

$$= H + 7.85$$

$H_w(H)$ Q Elev.

11.4(3.6) 1603 1203 $Q < Q_{INLET CONTROL}$

$$Q_{100} = 1830 \therefore H \approx 4.6 \text{ \& } H_w = 12.5$$

$$H_w EL. = 1204.1 > WEIR EL. BOT. = 1203.0$$

\therefore For 100 yr. Flow conditions - culvert will backwater to the existing weir but depth is insufficient to provide hydraulic control.

APPENDIX E

EXHIBITS

**REGIONAL VICINITY
AND
WATERSHED BOUNDARY MAP**

HARFORD, PA.

N4145—W7537.5/7.5

1968
PHOTOREVISED 1978
AMS 5867 I SW—SERIES V831

LENOXVILLE, PA.

N4137.5—7537.5/7.5

1946
PHOTOREVISED 1969
AMS 5867 II NW—SERIES V831

WATERSHED BOUNDARY

1000 0 1000 2000 FEET

SCALE 1:24,000

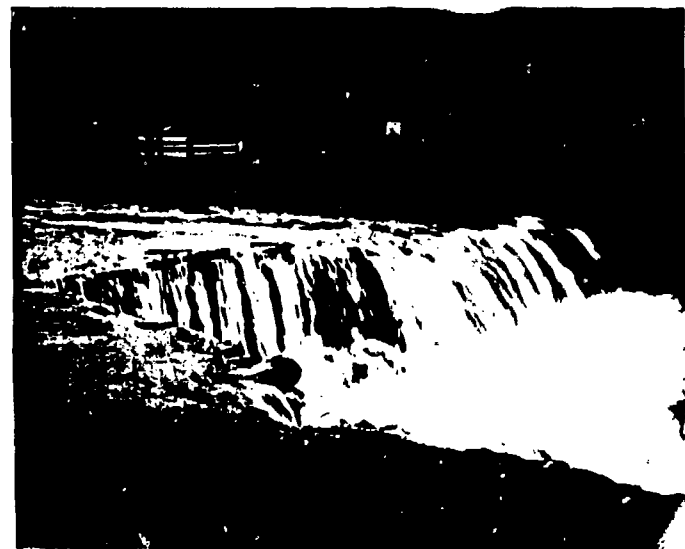
**LONGEST WATERCOURSE
CENTROID OF DRAINAGE AREA**

ACRE POND DAM

EXHIBIT E-1



8/27/67 FLOOD



11/9/72 FLOOD



2/24/75 FLOOD



2/24/75 FLOOD



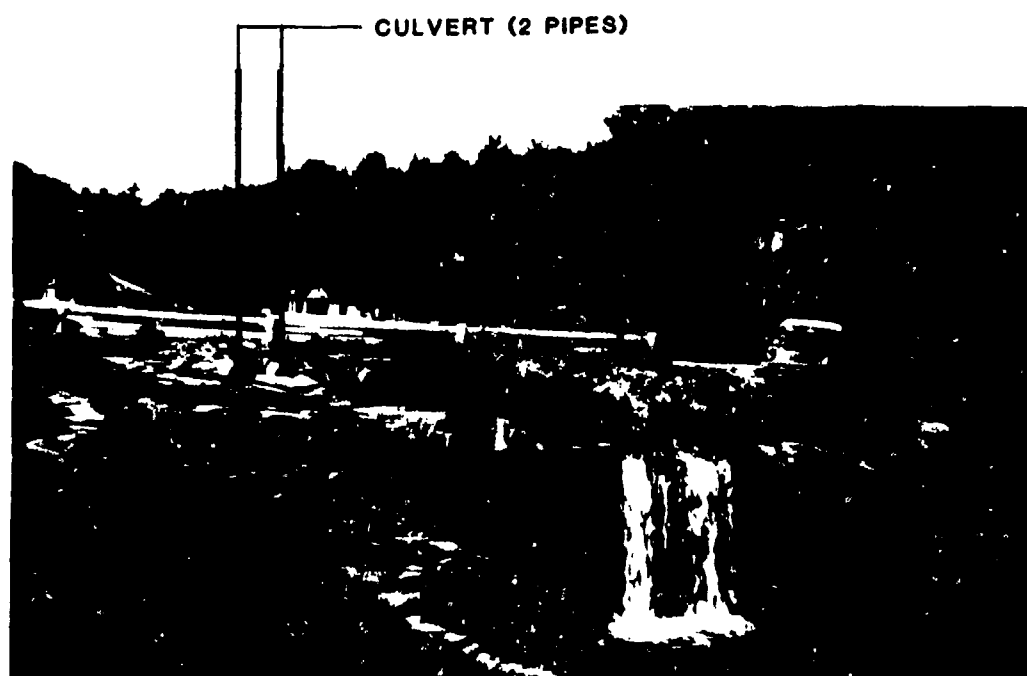
10/9/76 FLOOD



10/9/76 FLOOD



6/18/63 SHOWING ROAD ACROSS APPROACH CHANNEL



6/18/63 SHOWING DAM AND UPSTREAM CULVERT

APPENDIX F

GEOLOGY

ACRE POND DAM

APPENDIX F

GEOLOGY

The Acre Pond Dam and reservoir area are located within the Glaciated Allegheny Plateau Section of the Appalachian Plateau Physiographic Province. Deposits of glacial drift of variable thickness cover the entire area. The drift was deposited by the Wisconsin Ice Sheet during the Pleistocene period of geologic time.

The glacial drift is composed primarily of till which is a reddish-brown, unsorted, compact mixture of clay, silt, sand, gravel, and cobbles with occasional boulder size pieces. The stone pieces are sub-angular to rounded and consist mainly of sandstone and siltstone derived from the Catskill Formation, the dominant rock formation in the area. The clay content and compact nature of the till makes it a relatively impervious soil type. The dam abutments are underlain by such till.

Although depth to bedrock at the dam site is unknown, the steep earth slopes downstream of the dam indicate at least 12 feet of overburden soil.

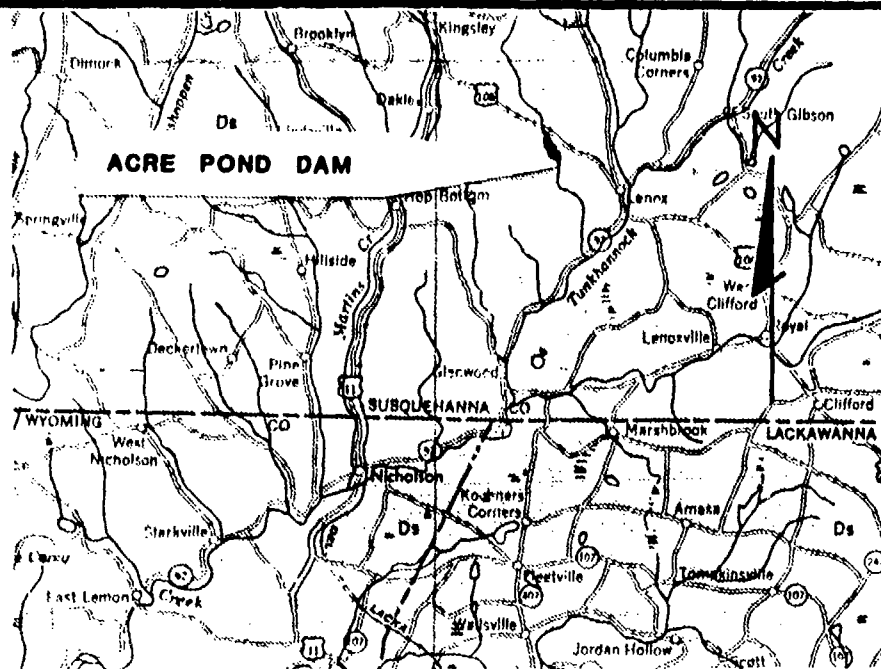
Some deposits of glacial outwash and Kame terraces are also found in the area. These deposits are composed of loose, poorly sorted to stratified deposits of silt, sand, and gravel. The Kame and outwash deposits are generally very pervious.

Other loose pervious soils in the area are the recent deposits of alluvial silt, sand, and gravel with some clay. These soils are localized and limited to streambeds and flood plain areas such as along Partners Creek downstream of the dam.

The bedrock underlying the entire dam and reservoir area is the Catskill Formation of the Susquehanna Group. This group of formations is of Upper Devonian Age. The Catskill strata generally consists of well indurated, red shale, siltstone and fine sandstone with some gray, green and brown shale, siltstone and sandstone layers. Occasional conglomeratic layers are encountered. The red shales are the dominant lithology and the residual soils derived from this rock are usually high in clay and silt content. The downstream face of the dam was constructed with Catskill Sandstone and shale boulders. No outcrops of bedrock were found at the dam site.

The regional structure of the bedrock in the area indicates that the bedrock underlying the dam and reservoir area is gently folded (dip 1°NW) to near-horizontal. The regional strike of the folds is N55°E.

Ref.: Ground Water of Northeastern Pennsylvania, Stanley W. Lohman, 1937; Bulletin W-4, Pennsylvania Geologic Survey.



0 1 2 3 4 5 10 MILES

SCALE. 1" = 4 MILES

LEGEND

DEVONIAN

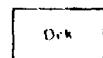
UPPER

CENTRAL AND EASTERN PENNSYLVANIA



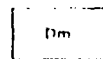
Oswayo Formation

Brownish and greenish gray, fine and medium grained sandstones with some shales and scattered calcareous lenses, includes red shales which become more numerous eastward. Relation to type Oswayo not proved.



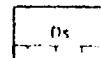
Catskill Formation

Chiefly red to brownish shales and sandstones, includes gray and greenish sandstone tongues named Elk Mountain, Haneydale, Shohola, and Delaware River in the east.



Marine beds

Gray to olive brown shales, argillaceous and sandstones, contains "Chemung" beds and "Portage" beds including Hurket, Huttler, Howell, and Trimmers Rock. Tully Limestone at base.



Susquehanna Group

Barbed line is "Chemung-Catskill" contact of Second Pennsylvania Survey. County reports, barbs on "Chemung" side of line.

NOTE:

GEOLOGIC MAP AND LEGEND
OBTAINED FROM GEOLOGIC MAP
OF PENNSYLVANIA BY PA.
TOPOGRAPHIC AND GEOLOGIC
SURVEY, DATED 1980

PHASE 1 INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM

ACRE POND DAM GEOLOGIC MAP

GEO - Technical Services, Inc.
HARRISBURG, PA

AUGUST, 1981

EXHIBIT F